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INTEGRATED MANAGEMENT OF *MELOIDOGYNE INCOGNITA* ON TUBEROSE USING *PAECILOMYCES LILACINUS* IN COMBINATION WITH PLANT EXTRACTS [1]

by
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Summary. A field experiment was conducted for the management of the root-knot nematode, *Meloidogyne incognita* infecting tuberose, *Polianthes tuberosa*, by integrating the use of the antagonistic fungus, *Paecilomyces lilacinus*, with leaf extracts of castor and neem as bulb treatments and soil drenches. Combination of *P. lilacinus* (at $2x10^4$ spores/ml) with 5% neem leaf extract resulted in significantly higher fresh plant weight and flower yield. Root gall index was least under *P. lilacinus* plus neem leaf extract (5%) combination followed by *P. lilacinus* plus castor leaf extract (5%) treatment. Although the per cent egg and egg mass parasitization by *P. lilacinus* was higher when integrated with the leaf extracts, neem leaf extract improved the parasitization by *P. lilacinus* more than that with castor leaf extract.

Commercial cultivation of tuberose (*Polianthes tuberosa* L.) is seriously limited by root-knot nematodes, *Meloidogyne* spp. (Sunderababu and Vadivelu, 1988). *Meloidogyne incognita* has been reported to cause 10% and 14% reduction in flower number and spike weight, respectively (Khan and Parvatha Reddy, 1992). Application of combinations of antagonistic fungi and plant extracts has provided effective management of root-knot nematodes on many crops (Bhattacharya and Goswami, 1987; Rao and Parvatha Reddy, 1994). The efficacy of the antagonistic fungus, *Paecilomyces lilacinus* in combination with castor and neem leaf extracts was tested as a bulb dip and soil drench for the management of *M. incognita* infecting tuberose.

Materials and methods

A local isolate of *P. lilacinus* (Thoms) Samson was cultured on paddy grain in 500 cc bottles and incubated at 22 °C. Thirty days after incubation, the cultures were washed through a 100 mesh sieve and the fungal spores were collected. The inoculum was prepared by adjusting the spore concentration to $2x10^4$ spores/ml of water through serial dilution using a haemocytometer.

Fresh leaves of castor (*Ricinus communis Merr.*) and neem (*Azadirachta indica* A. Juss) were separately homogenized in a Waring blender with water (5:100 w/v) and strained through muslin cloth to obtain 5% leaf extracts. Stock solutions of fungal spores were mixed

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with concentrated leaf extracts to make the final spore concentrations of 2×10^4 spores/ml and leaf extract concentration 5% (w/v).

Bulbs of tuberose, both single and double types, were soaked for 20 minutes in the suspensions as indicated in Table I. The bulbs were then shade dried. Five bulbs each of the treatments with *P. lilacinus*, *P. lilacinus* + neem leaf extract and *P. lilacinus* + castor leaf extract were carefully washed with a camel hair brush and the spores of the fungus adhering to them were counted using a haemocytometer.

A field infested with *M. incognita* (Kofoid *et* White) Chitw. was divided into 1.5x1.5 m plots and the treated bulbs of single type and double type were separately planted, 16/plot (spacing, 30x30 cm). Treatments were randomly distributed and replicated three times. Usual agronomic practices for the cultivation of tuberose were followed. Thirty days after planting, the same treatments (Table I) were applied as soil drenches at 50 ml per plant to the respective treated plots. Carbofuran (2.5 kg/ha) was applied to selected plots and the two tuberose types were grown following the same agronomic practices, to serve as control.

Fresh plant weight, mean spike number/plot, mean spike length and weight, floral number/-spike, and root gall index were recorded 90 days after planting. The roots were collected separately from the plants treated with *P. lilacinus* and its combinations with leaf extracts. The number of parasitized and healthy egg masses were counted (for calculating the per cent egg masses parasitized). The parasitized egg masses were treated in 0.2 per cent NaOCl for 2 minutes and the number of eggs parasitized and the total number of eggs per egg mass were

TABLE I - *Effect of bulb dip and soil drench treatments with combinations of* Paecilomyces lilacinus *and plant extracts on tuberose (single type) infested with* Meloidogyne incognita.

Treatment	Number of spores adhered/bulb	Fresh plant weight (g)	Mean Spike			Flower Number/ Spike
			Number/ Plot	Length (cm)	Weight (g)	
M. incognita	–	65 (-7.1)	14 (-22.2)	66 (0)	30 (-11.7)	12 (-14.2)
Control (Carbofuran 2.5 kg ai/ha)	–	70 (0)	18 (0)	66 (0)	34 (0)	14 (0)
P. lilacinus	3.5×10^2	70 (0)	18 (0)	68 (+3.0)	38 (+11.7)	16 (+14.2)
Castor leaf extract	–	72 (+2.8)	21 (+16.6)	75 (+13.6)	36 (+5.8)	18 (+28.5)
Neem leaf extract	–	74 (+5.7)	24 (+33.3)	72 (+9.0)	40 (+17.6)	21 (+50.0)
P. lilacinus + castor leaf extract	6.8×10^2	74 (+5.7)	25 (+38.8)	78 (+18.1)	44 (+29.4)	24 (+71.4)
P. lilacinus + neem leaf extract	7.4×10^2	83 (+18.5)	30 (+66.6)	90 (+36.3)	50 (+47.0)	28 (+100.0)
C.D. at 5%	–	5.25	4.46	10.59	4.39	3.70

Values in parentheses give the per cent increase or decrease over the values under sterile soil condition.

counted to determine percentage of parasitized eggs per egg mass. At the same time, the parasitized egg masses were checked for *P. lilacinus* parasitization using the semi-selective medium (Mitchell *et al.*, 1987). The number of juveniles per 100 cc of soil and per 5 g of root were also recorded from each treatment to calculate multiplication rate (P final/P initial). The average initial nematode soil population was observed to be 48 per 100 cc soil. Data were subjected to analysis of variance according to modified Duncan's multiple range test (Steel and Torrie, 1980.

Results and discussion

The number of *P. lilacinus* spores adhering to the bulbs treated with *P. lilacinus* was significantly higher when leaf extracts were integrated with spore suspension (Table I). The number of spores adhering was higher in neem leaf extract plus *P. lilacinus*, compared to that in castor leaf extract plus *P. lilacinus*.

Plants treated with either *P. lilacinus*, leaf extracts or their combinations significantly increased fresh plant weight, mean spike number/plot, mean spike length and weight, and floral number/spike over that of untreated (*M. incognita* infested) control (Tables I and II). Both the single and double types recorded highest values of floral parameters when they were treated with combination of *P. lilacinus* plus neem leaf extract followed by that of *P. lilacinus* plus castor leaf extract combination. The per cent increase in fresh plant weight, mean spike number per plot, and mean spike weight were highest (39.5, 77.7 and 88.8 per

TABLE II - *Effect of bulb dip and soil drench treatments with combinations of* P. lilacinus *and plant extracts on tuberose (double type) infested with* M. incognita.

Treatment	Number of spores adhered/bulb	Fresh plant weight (g)	Mean Spike			Flower Number/ Spike
			Number/ Plot	Length (cm)	Weight (g)	
M. incognita	–	70 (-19.0)	18 (0)	64 (-5.8)	40 (-11.1)	18 (-14.2)
Control (Carbofuran 2.5 kg ai/ha)	–	86 (0)	18 (0)	68 (0)	45 (0)	21 (0)
P. lilacinus	5.9×10^2	90 (+4.6)	20 (+11.1)	70 (+2.9)	45 (0)	21 (0)
Castor leaf extract	–	92 (+6.9)	24 (+33.3)	68 (0)	46 (+2.2)	24 (+14.2)
Neem leaf extract	–	98 (+13.9)	24 (+33.3)	70 (+2.9)	65 (+44.4)	27 (+28.5)
P. lilacinus + castor leaf extract	11.1×10^2	95 (+10.4)	28 (+55.5)	75 (+10.2)	70 (+55.5)	28 (+33.3)
P. lilacinus + neem leaf extract	12.8×10^2	120 (+39.5)	32 (+77.7)	80 (+17.6)	85 (+88.8)	34 (+61.9)
C.D. at 5%	–	6.15	4.11	9.66	7.22	3.88

Values in parentheses give the per cent increase or decrease over the values under sterile soil condition.

cent, respectively) in double type tuberose, when treated with *P. lilacinus* plus neem leaf extract, compared to that of single type tuberose under same treatment (18.5, 66.6 and 36.6 per cent, respectively).

Least root-gall index and nematode multiplication rate (1.0 and 2.41, respectively) were recorded under *P. lilacinus* plus neem leaf extract treatment in double type tuberose, whereas in single type, root-gall index was least (1.5) under *P. lilacinus* plus neem leaf extract treatment, and the nematode multiplication rate was lowest (1.83) when treated with *P. lilacinus* plus castor leaf extract (Table III).

The per cent egg and egg mass parasitization by *P. lilacinus* were significantly higher in both the single and double type tuberoses, when integrated with leaf extracts. Highest egg and egg mass parasitization (24.3 and 28 per cent, respectively) was recorded under *P. lilacinus* plus neem leaf extract treatment in double type, and single type (23.3 and 25 per cent, respectively). The increased number of *P. lilacinus* spores adhering to the bulbs when integrated with leaf extracts, could be the reason for increased egg and egg mass parasitization by *P. lilacinus* under *P. lilacinus* plus leaf extracts treatments. Besides, the aqueous leaf extracts along with *P.*

TABLE III - *Effect of* P. lilacinus, *plant extracts combination on* M. incognita.

Treatment	Root gall index (RGI)	Per cent parasitization of		Nematode Multiplication Rate (N.M.R.)
		Egg masses	Eggs	
Single type				
M. incognita	2.5	–	–	2.54
P. lilacinus	2.0	12	16.3	2.33
Castor leaf extract	2.3	–	–	2.50
Neem leaf extract	2.3	–	–	2.02
P. lilacinus + castor leaf extract	2.0	16	19.4	1.83
P. lilacinus + neem leaf extract	1.5	24	23.3	1.87
C.D. at 5%	0.57	2.38	2.62	0.21
Double type				
M. incognita	2.8	–	–	3.41
P. lilacinus	2.5	14	18.0	3.12
Castor leaf extract	2.8	–	–	3.13
Neem leaf extract	2.5	–	–	3.00
P. lilacinus + castor leaf extract	2.5	18	19.8	2.90
P. lilacinus + neem leaf extract	1.0	28	24.3	2.41
C.D. at 5%	0.44	3.09	2.02	0.11

lilacinus spores as soil drench provided the moisture and organic substrate for the fungus. Possibly the bulb treatment gave protection from nematode infection in the initial crop growth stages which was further enhanced by subsequent soil drench in the main field. However, the feasibity of application of leaf extracts over large areas is subject to the availability of large quantities of leaf. Therefore, application of leaf extracts in combination with antagonistic fungi like *P. lilacinus* could be promoted in nursery beds, highly infested (nematode-sick) soils and commercial polyhouses as seed dressings, split doses and spot drench applications.

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